# Virtual Reality Systems for Serious Games on the subject of dive simulation

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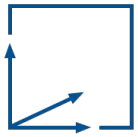


Final: Bachelor Informatik: Games Engineering

Supervisor: Prof. Gudrun Klinker, Ph.D.

# Introduction & Motivation

- Virtual Reality (VR) is a rapidly evolving technology.
- Increasingly suitable for training and education.
- Simulation of hard to reach environments might be possible.

- We are PADI trained divers.
- Diving requires training and education that could profit from interactive learning.
- Travel restricted due to COVID-19 pandemic.
- Diving spots are hard to reach and museums are closed.
- VR could offer the solution to these problems.

# Problem

- Can diving be realistically simulated using modern VR technology?
- What sensations have to be simulated to create an authentic diving experience?
- Which existing or future technologies could be used to create this sensory information?
- How would a VR System for dive simulation be designed and built?
- Is the resulting serious game immersive and can it be used for training purposes?
- How could such a system be further improved in the future with new experimental technology.

# Related Work

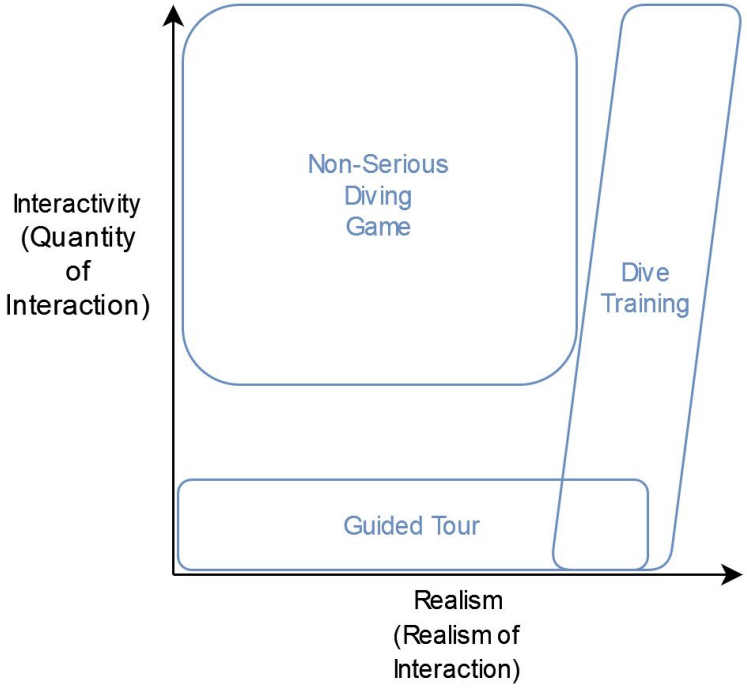
- *The **Dawn of Art*** is a short VR experience showcasing the *Chauvet Cave* and the historical art findings located within.
  - Also offers a small 3D movie.
- ***DIVR*** is a combination of hardware and software, which allows players to experience VR environments while swimming.
  - An alternative for use in waterslides shows additional use-cases.
- The ***VISAS Project*** proposes a pipeline for asset acquisition in underwater UCH sites and built a VR experience to make the environment accessible.

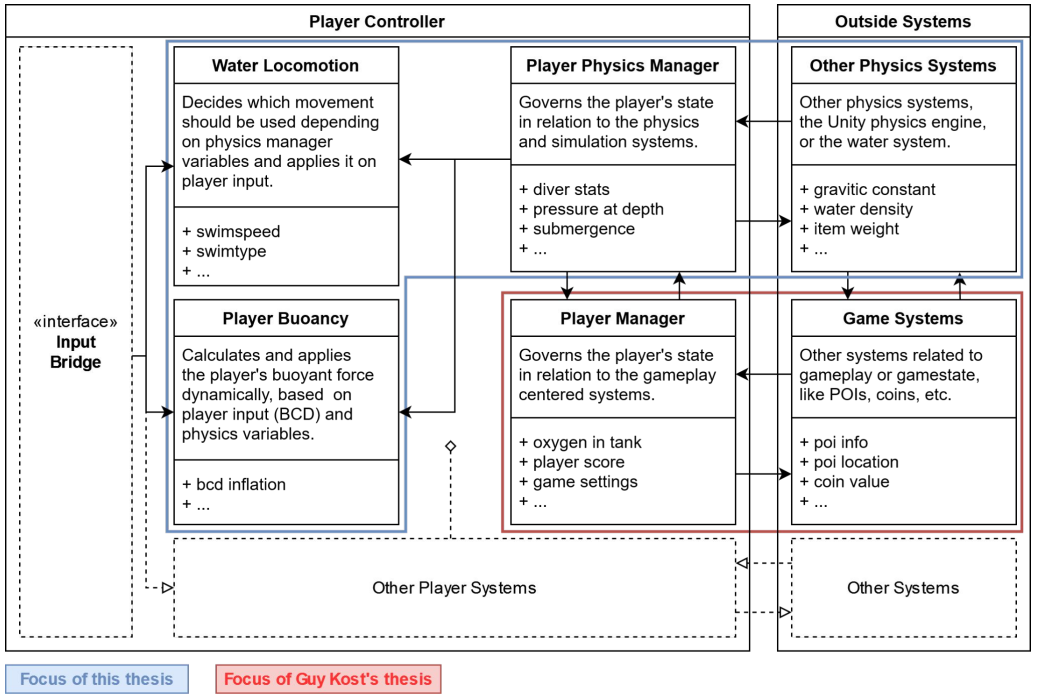
# Goals of this Thesis

- Explore the state of the art of immersive VR technology.
- Highlight promising solutions for the simulation of diving in VR.
- Design a modular and variable VR System for authentic dive simulation for different use-cases.
- Construction of a vertical slice prototype of the system to evaluate the design and implement a foundation.
- Outline possible future work in relation to the design and prototype development.
- Propose an evaluation strategy through a user-study.

# Design

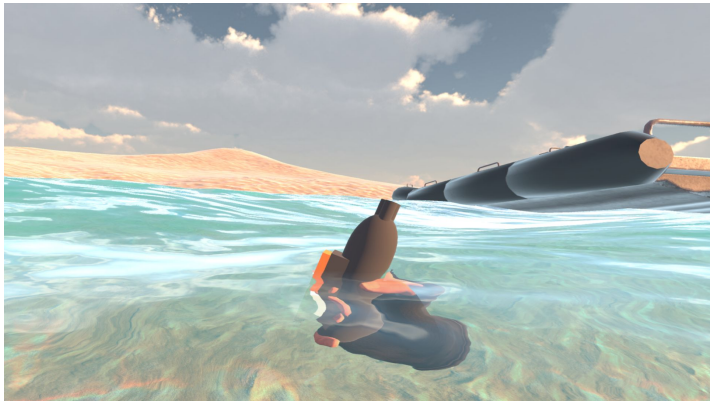
- Design philosophy: Modularity & Variability.
- HMD based VR instead of Desktop or CAVE.
- Module based for easy configuration and extension.



# Implementation (200Bar Prototype)

- Proof of concept.
- Vertical slice.
  - Not strictly modular.
  - Focus on base functionality.
- Rapid iterative development
- Implementation of base game-play and physics calculations.
- Physical (breastrokes) and virtual (controller) based movement support.
- Replica of Caesarea Maritima as central level for gameplay.



# Video

# Evaluation Design

- Evaluation of prototype in a user-study consisting of three different questionnaires.
- Immersive Experience Questionnaire (IEQ)
  - Used to measure the immersion experienced by players in several categories.
- Virtual Reality Sickness Questionnaire (VRSQ)
  - Improved evolution of the popular Simulator Sickness Questionnaire (SSQ).
  - Evaluates the possibility of VIMS in players of the game.
- Diving Experience Questionnaire
  - Used to evaluate the educational value of the prototype and allows data collection to adjust results based on user experience.
- Study could not be performed due to Covid-19.

# Suggested Future Work

- Conduct the outlined user study with different groups of participants (normal users, experience VR players, experienced divers).
- Continue development of design and prototype:
- Improve audiovisual fidelity of the experience.
  - Usage of more high quality assets.
  - Cooperation with other researchers to acquire these.
  - Development of asset import pipeline for conversion of real world scanning data into game assets.
  - Use special hydrophones to capture high quality audio for a dynamic audio system.
- Experiment with and potentially include specialised hardware into the game for elevated experience.

# Conclusion

- Aim: Explore modern VR technology and design for the use in realistic and authentic diving simulation.
- VR is likely suitable technology in the context of a Serious Game.
- Particularly when immersive and realistic virtual environments are combined with authentic, engaging gameplay.
- Prototype provides an early look at the possibilities and could be used to facilitate immersive entertainment or accessible dive training.
- Further work required to refine design and game.

# Thank you!